REMARKS

Reconsideration of the present application in view of the foregoing amendments and the following remarks is respectfully requested. Claims 1-16 remain in the application.

Turning now to the 102 rejections, Applicants believe that the amended independent claims better clarify and particularly point out that which the Applicants believe to be the subject matter as described in those claims.

Claim Rejections - 35 *U.S.C.* § *102*

In the Office Action, claims 1-6 (?16) were rejected under 35 U.S.C. §102(b) as being anticipated by 2003/0209485 (application publication corresponding to serial No. 10/275,210, which claims priority over PCT/US01/16817, with priority on 60/206,623, filed on 5/24/2000) to Kools et al. as follows:

> 2. Claims 1-6 are rejected under 35 U.S.C. 102(e) as being anticipated by Kools (2003/0209485(application publication corresponding to serial No.10/275,210, which claims priority over PCT/US01/16817, with priority on 60/206,623, filed on 5/24/2000)). Kools discloses a multilayer membrane and the process of making the membranes by co-casting, forming continuous layers (page 15, lines 11-21, page 7, sections 0035-section 0037). The membrane is also defined in the published application as unsupported, and with no demarcation line between layers (sections 0046-0047). Regarding claims 1, 15, and 16, the membrane layers are disclosed as being asymmetrical and symmetrical (page 10, section 0053, lines 3-14, Fig. 16).
>
> As to claim 2, producing the membrane from two distinct polymer dopes is also disclosed in the publication (page 10, section 0053, lines 3-14, Fig. 16).
>
> Regarding claims 6, and 8, the type I (as defined having the larger pore size as upstream), is disclosed by the publication (section 0053, last five lines).
>
> As to claim 7, e. g. symmetrical membrane (section 0053).
>
> As to claim 9-14, forming multilayers with the layer of smaller pore size being within the depth of the cross section of the membrane structure is suggested in the publication (section 0053, and 0055). Combinations of distinct or same pore layers and polymers

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composition are disclosed in the prior discussed sections.

3. As to claim 16, the minimum shear turbulence induce interlayer mixing of the unsupported membrane is inherent of the co-casting process from which the membrane of the publication ('485) is made.

Applicants hereby traverse the Examiner's 35 U.S.C. §102 rejections and respectfully submit that all currently pending claims are patentably distinguishable over Kools. Concerning the 35 U.S.C. § 102(b) rejections, as the Examiner knows, MPEP §2131 provides:

> "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. Of California,* 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as contained in the ... claim." *Richardson v. Suzuki Motor Co.,* 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim.

Contrary to Examiner's assertions Kools does not disclose all elements of any of the present independent claims, either explicitly or inherently. Concerning the Examiner's rejection of the claims, it is respectfully submitted that the presently applied reference does not disclose suggest or teach that which all present independent claims require that being "...the first and second layers being operatively connected with a **distinct** change in pore size at the **interface** thereof...," which is the opposite of the discernable interfacial zone providing a subtle pore size change between zones as taught by the Kools reference, as clearly demonstrated by the Kools disclosure. Thus, Applicants respectfully submit that the Kools reference does not anticipate the present independent and dependent claims as presently amended in that the Kools reference does not disclose, suggest or teach "...the first and second layers being operatively connected with a **distinct** change in pore size at the **interface** thereof...," as now required by the amended independent claims.

As the Examiner may recall, the International Publication WO 01/89673 A2 to Kools corresponding to PCT/US01/16817, with priority on 60/206,623, filed on 5/24/2000, was addressed in the present disclosure at page 6, lines 18-25, as follows:

> PCT publication WO 01/89673 A2 to Kools, the disclosure of which is herein incorporated by reference to the extent not inconsistent with the present disclosure, appears to disclose 'co-casting' as a method to make

multilayer PVDF membrane. The Kools' disclosure has as its salient point post-metering coating apparatus which apparently results in **high interfacial shear turbulence**, which results in an **asymmetric transition zone**, having a **different pore size from either of the two adjacent layers, in the interface zone**. It is believed that the Kools structure, as disclosed will result in the undesirable FFBP as discussed below. (Emphasis added)

Applicants further addressed the differences between the Kools' reference and the present disclosure at page 7, lines 36-37, continuing on page 8, lines 1-35 and page 9, lines 1-5, as follows:

The present disclosure is directed to unsupported (without an integral reinforcing or supporting porous support) multilayer microporous membrane, apparatuses and processes for the manufacture thereof. The unsupported membrane may be substantially simultaneously formed into multiple (two or more) discrete layers, each with, presently preferably, a different but controlled pore size. The unsupported membrane may also comprise multiple (two or more) discrete layers each with, presently preferably, a different but controlled pore size, with a **distinct** change in pore size at the interface between each of the layers that does not exhibit locally **asymmetric pore size distributions**, such that the resulting membrane exhibits a Type I Forward Flow Bubble Point (FFBP) curve response, as illustrated in Figures 16 a and 16 c, and demonstrated in Figure 12 and discussed below.

Layers of dope that eventually form the layers are applied directly to one another prior to the membrane quench such that interfacial turbulence and gross mixing between adjacent layers are avoided , maintaining **distinct** pore sizes within the separate layers but where the separate layers are integrally joined at each interface. A multilayer membrane structure results from the process step of applying the individual dopes or polymer solutions that form each of the layers sequentially onto one another, the resulting multilayer liquid coating, subsequent to being subjected to a process step that induces phase inversion that forms the **distinctly sized pores** in each layer, with each porous layer being physically bonded to its' adjacent porous layer by polymer intermingling, at a molecular scale, at the interface but **without any extensive intermixing in the interfacial regions between the layers**, as will be explained in more detail below.

The application is, presently preferably achieved, with a **pre-metered** coating system which **does not** introduce **any significant shear turbulence at the interface** between adjacent dope or polymer solution layers. The present applicants have determined that this absence of significant shear turbulence is in contrast to a **post-metered** coating system, such as **knife coating**, which has now been determined to create significant shear turbulence between each of the applied liquid layers, as discussed in the Kools

> publication. The applicants of the present disclosure believe that they have replicated the Kool's **post-metering** process to produce a two layer membrane. The FFBP of the Kool's membrane resembles that shown in Figure 7. In light of Figures 16 b and 16 d, the interface of Kool's process appears to indicate the presence of a **significant asymmetric zone** at the interface. The results obtained appear to verify the disclosure as contained in the Kools publication.
>
> This discernable transition layer occurs whether the two dope or liquid polymer layers are applied by two separate casting knifes located some distance apart, as in one experiment, or whether the **two casting knifes are built into a single assembly** so that there is essentially zero gap between the two polymer solution applications, as disclosed in the Kool's publication . (Emphasis added)

Our intended abrupt/distinct pore size change interface is visually evident in SEMs. Visual examination of the membranes produced by following the teachings of the Kools applied reference are somewhat ambiguous because there is an interfacial zone wherein the pore size gradually changes from the pore size of one layer to the pore size of the other layer. Fortunately, the existence of this transitional interfacial structure can be identified and contrasted to the abrupt/distinct transition disclosed in our present application. The industry standard Forward Flow Bubble Point Test (FFBP) is capable of differentiating between the "subtle" transitional structure of the Kools applied reference and the abrupt/distinct pore size change interface disclosed in the present application. Specifically, the Examiners attention is directed to the following discussion at page 23, lines 30-36 continuing on page 24, lines 1-4, as follows

> Comparing Figure 7 with Figures 8 and 9 however, reveals that the transition between layers, induced by the doctor blade, caused a Type II FFBP curve as illustrated in Figure 16 d and demonstrated in Figure 7. This response was not evident when the membrane was tested in reverse. Therefore, while a doctor blade provides a continuous interface between the layers, a doctor blade also produces **an asymmetric interfacial transition zone**. This phenomenon **is not** *obviously revealed* by **SEM** but can be **readily seen** with a **FFBP analysis**. Of the various examples generated with the doctor blade, Figure 7 represents the best performance obtained using the post-metering apparatus and all other such examples run yielded even greater differences between the slopes generated with opposite membrane orientations. (Emphasis added)

The above was confirmed for Nylon membrane at page 26, lines 10-20 and continuing on page 27, lines 1-18, as follows:

> Figure 12 show forward flow bubble point curves for nylon membrane wherein pressure is ramped continuously on a membrane wetted with about 60% IPA and about 40% water and the flow was monitored with a mass flow meter. As is known, flow is a measurement of either diffusion through the wetted membrane or bulk flow through the cleared pores or a combination.
>
> When a membrane consisting of a single layer was tested, the response curve was **independent of orientation**, as illustrated above for the PVDF membrane. However, when an unsupported, multilayer membrane of the present disclosure was tested, the **response curve differed**, depending on whether the **larger pore size layer** was **upstream or downstream** relative to the smaller pore size layer. If the larger pore size layer was **upstream**, when the pressure necessary to clear those pores was reached (the bubble point), the larger pore size layer **suddenly cleared**. At this point, the liquid will progress down until the smaller pore size layer just beneath the larger pore size layer is reached. However, once the pores of the larger pore size layer has cleared, the diffusion response also increased because the air no longer must diffuse through the entire depth of the membrane, but only through half of the membrane, the smaller pore layer.
>
> On a forward flow bubble point (FFBP) curve, this transition causes an increase in the mass flow response. If a membrane was tested with the relatively smaller pore size layer toward the air interface, then the pores will not clear until the relatively smaller pores have reached their bubble point, at which time the entire membrane clears. Since the membrane remained fully wetted during the entire test, the diffusion does not increase during the latter part of the test.
>
> This **difference** is best illustrated in Figure 12 wherein two curves are displayed for the same membrane sample. As shown, when tested with the relatively larger pore size layer upstream, the mass flow rose above the baseline at the bubble point of the relatively larger pore size upstream layer but **did not experience bulk flow** until the **relatively smaller pore size pores were cleared as well**. (Emphasis added)

As would be understood by one of ordinary skill in the art, the Kools references fails to disclose, suggest or teach the detailed and specific material above. In fact, Kools discloses, suggests and teaches something quite different, as pointed out above. Specifically, Kools discloses at paragraph 0035 of the US Publication as follows:

> ...a method of producing an integral multilayered porous membrane by **co-casting** a plurality of polymer solutions onto a support to form a multilayered liquid sheet and immersing the sheet into a liquid coagulation bath to effect phase separation and form a porous membrane. (Emphasis added)

By "**co-casting**" it is meant that a casting head such as the doctor blade arrangement in Figure 1 is used, where two adjustable blades and a back wall define the fluid flow on to the casting surface. The process disclosed by Kools is uniquely suited to producing the interfacial structure that Kools discloses, namely a transition zone wherein the pore size gradually changes from the pore size of one layer to the pore size of the adjacent layer **thereby resulting in asymmetric zones**. Following the Kools disclosed method produces a very high interfacial velocity difference; i.e., at the point where the two fluid streams join at the tip of the second doctor blade, the velocity of the first cast fluid is essentially that of the support or casting surface while the velocity of the subsequently cast fluid is zero. The high interfacial velocity difference results in high shear, non-laminar turbulent flow (hydrodynamic non-equilibrium) which, in turn, induces mixing of the two fluids. This is further defined in the Kools US Publication in paragraph 0036 as follows:

> **...Co-casting** is **an** ***important aspect*** of the ***invention*** **because it allows for formation of controlled pore size regions at the junctions of layers**....Possibly due to partial mixing of adjacent co-cast lacquers or due to high shear forces at the interface between two adjacent co-cast lacquers, **a sharp interface can be replaced by a more subtle change in pore size between two adjacent layers**. Such an **interfacial zone is beneficial for the retentive behavior of the overall structure of the membrane. At the same time, it** ***allows the formation of microporous structure with no discernable demarcation line in the structure.*** (Emphasis added)

and later in the Kools disclosure at paragraph 0047, as follows:

> The process of ***this invention*** (the Kools invention) also allows for independent casting of very thin layers. Layer thickness depends not only on the casting device geometry but also on flow and viscosity of both lacquers. In the process of this invention, the **well-defined demarcation line** seen in prior art between the two layers **can be significantly reduced or avoided**. **A drastic change in pore size going from a more open to a more tight structure can lead to undesirable fast accumulation of particles at the interface and consequently a drastic flux decline.** Possibly due to partial mixing of adjacent co-cast lacquers or due to *high shear forces* at the interface between two adjacent co-cast lacquers, ***a sharp interface*** **can be replaced by a** ***more subtle change in pore size between two adjacent layers***. **Such an interfacial zone is beneficial for the retentive behavior of the overall structure of the membrane.** At the same time, it allows the formation of

> microporous structure with ***no discernable demarcation line in the structure.*** (Emphasis added)

The present inventors were able to produce the membrane, as described in the present independent claims, because they ***cooperatively applied the polymer dopes*** to the coating surface, as disclosed in the present application at page 13, lines 18-21, as follows:

> By the term "**cooperatively applying polymer dopes**," we mean that the multiple coating dope layers form cooperatively in such a manner that there is **hydrodynamic equilibrium** i.e., there is **no significant interfacial shear turbulence** between the two liquid layers. (Emphasis added)

As the Examiner may know, the normal meaning of "**hydrodynamic equilibrium**" is that there is no mixing between flow lines, implying that any flow in a direction orthogonal to the direction of bulk flow would result in a departure from this equilibrium. It is clear that, according to the present disclosure, the polymer dope layers are flowed together, by means of **pre-metered flow**, so that the velocity difference at the interface between the two fluid layers is **essentially zero**. This factor, in conjunction with the high viscosity of the polymer dopes, results in **laminar flow with no turbulence** and, thus, substantially no mixing of the dopes at the interface. Since the pore size of each layer is uniquely determined by the formulation and thermal history of each dope, this elimination of interfacial mixing results, after phase inversion, in an interface where there is an abrupt/distinct change in pore size and a visually obvious abrupt/distinct demarcation line between the adjacent **symmetrical** zones. This intended result is precisely the opposite of the **formation of microporous structure with no discernable demarcation line in the structure** resulting in an asymmetric transition zone between adjacent zones, as clearly disclosed and taught as the intended result by the Kools applied reference. (Emphasis added)

Therefore, the Kools reference not only fails to disclose, suggest or teach the elements of the present independent claims, Kools **teaches away** from the present independent claims. In fact, the present independent claims all require, as pointed out above, that the layers comprise **symmetrically distributed** pore sizes and that "...the first and second layers being operatively connected with a **distinct** change in pore size at the **interface** thereof...," which is the opposite of the discernable interfacial zone providing a subtle pore size change between **asymmetrical** zones, as taught by the Kools reference and illustrated in paragraphs [0056] and [0057].as follows:

> FIG. 15 shows a cross-sectional microphotograph of a multilayered structure of the present invention wherein both layers are **asymmetrical**.
>
> FIG. 16 shows a cross-sectional microphotograph of a multilayered structure of the present invention wherein one layer, in this instance the top layer is symmetrical and the bottom layer is **asymmetrical**. (Emphasis added)

Since the Examiner has failed to make a prime facie case of anticipation, Applicants respectfully submit that the claims, as currently amended, are allowable and an action acknowledging same is respectfully requested.

Thus, it is Applicant's position that the application is now in condition for allowance and an action acknowledging same is respectfully requested.

If after reviewing this amendment, should the Examiner have questions or require additional information, she is cordially invited to call the undersigned attorney, so this case may receive an early notice of allowance. Such action is earnestly solicited.

Any fees or charges due as a result of filing the present paper may be charged against Deposit Account No. 033879.

Respectfully submitted,

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